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(54) IMPROVEMENTS IN OR RELATING TO IMPELLERS OF PUMPS FOR COOLING SYSTEMS OF INTERNAL COMBUSTION ENGINES

(71) We, SOCIETE INTERNATIONALE DE MECANIQUE INDUSTRIELLE S.A., a corporate body, organized under the laws of Luxembour, of 37, rue Notre Dame, Luxembourg (Grand Duche), do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates in general to pumps of the type used in the cooling systems of internal combustion engines and has specific reference to an improved impeller or rotor for such pumps.

It is known that heretofore, these impellers consisted mainly of cast iron and more recently of pressed metal, in contrast with the impellers of modern washing machines which consist essentially of plastics material.

Yet, the advantages to be expected from the use of plastics materials in the manufacture of pump impellers for the cooling system of internal combustion engines are well known; low cost, easy moulding and stripping under mass-production conditions, easy obtaining of functional shapes with smooth surfaces permitting an improved efficiency in actual service, light weight and ensuring a satisfactory dynamic balance, reduction noise and vibration, etc.; unfortunately, notwithstanding the considerable research and test works accomplished in this field, it has not been possible up to now and so far as the Applicant is aware to manufacture impellers of plastics material capable of withstanding satisfactorily and for a reasonably long time the specific conditions of operation in pumps equipping the cooling systems of internal combustion engines.

It is obvious that these impellers operate under conditions differing considerably from those encountered in laundry washers and dishwashers; in fact, in these machines the rotational speed is always below 3,000 r.p.m. and the temperature not in excess of 98°C.; on the other hand, in internal combustion engines rotational speeds as high as 9,000 r.p.m. and temperatures of the order of 130°C are frequently encountered; therefore, the mechanical and thermal stresses involved differ completely and it was currently admitted that plastics materials could not withstand such stresses, so that the use of these materials had to be definitely precluded in the manufacture of impellers for the pumps of cooling systems of internal combustion engines.

Now it was found according to the present invention that it was possible to obtain a pump impeller for pumps of the type incorporated in the cooling system of internal combustion engines, said impeller comprising a metal hub adapted to be force-fitted on the pump shaft, and an impeller proper having one portion of said hub embedded therein, said impeller consisting of a mixture of thermosetting resin having a low coefficient of water absorption when heated, and a filler which is both water-repellent and not liable to change its dimensions in the presence of water.

Thus, notably, it was found that a filler consisting of short asbestos fibres was perfectly suited for the purpose, inasmuch as the cost of these fibres is very low; glass fibres may also be used provided that they are of reduced length. The ratio (by weight) of fibres to the moulded plastic may vary from 35% to 60%.

As a thermosetting resin, certain phenol-formaldehyde resins (of the "Notolaque" type) are adequate for the purpose.

According to a typical form of embodiment of this invention, the impeller fitted to a metal hub comprises an impeller body constituting the blade hub and having a diameter increasing gradually towards the outer periphery, said body being bounded on the inner side by an internally concave surface from which the impeller blades project; the maximum diameter of the impeller body is preferably the same as the outer diameter of said blades, so that the assembly is inscribed in a cylinder.

If desired, the impeller body may com-

[*Price 33p*]

prise on its rear face a sealing ring adapted to be kept in frictional contact with a counter-ring associated with the adjacent wall of the water pump in order to provide the necessary fluid-tightness; if desired, this counter-ring may be fitted in the impeller body proper with the interposition of an elastic material such as rubber.

This type of impeller can easily be force-fitted to the pump shaft by using a press and a suitable jig.

When the degree of precision of the hub and shaft is relatively high, the fitting step is not attended by any difficulty; on the other hand, if it is desired to reduce costs by resorting to a less accurate manufacture, the maximum shrinking force obtained through a proper selection of the tolerances between a hub of minimum diameter and a shaft of maximum diameter must be increased. As a result, at the limit, the filled thermosetting resin constituting the impeller proper (which has one portion of the hub embedded therein) would break up due to the overstepping of its elastic elongation limit.

According to a modified form of embodiment of this invention which is intended for avoiding this invonvenience while affording a considerably greater safety margin under mass-production conditions, the metal of this impeller comprises a sleeve constituting the hub proper which is connected through a curved intermediate portion to an end or outer portion and it is this portion alone that is embedded in the plastics impeller proper.

In the accompanying drawings:

Figure 1 is a front view of one embodiment of a composite impeller according to the invention;

Figure 2 is a longitudinal section through Figure 1;

Figures 3 and 4 are longitudinal sections similar to Fig. 2 showing two other forms of embodiment of the composite impeller of this invention;

Figures 5 and 6 are a diametral section and a front view, respectively, of one form of the metal hub utilized in this invention;

Figure 7 is a diametral section illustrating on a larger scale a modified form of embodiment of the impeller of this invention;

Figures 8 to 12 illustrate other modifications of the metal hub incorporated in the pump impeller;

Figure 13 is a sectional view of another form of embodiment of this invention, showing the impeller fitted to the pump shaft, and

Figure 14 is another modified form of embodiment of the metal hub of the pump impeller.

The impellers or rotors illustrated comprise a metal hub 1 adapted to be press- or force-fitted to the pump shaft, this hub 1 constituting an insert of which one portion is adapted to be embedded by molding in the impeller body 2; to this end, each metal hub has an integral castellated outer peripheral portion 3 affording a reliable anchoring of the hub 1 in the body 2; the impeller body may have a wide range of shapes and dimensions as required for the specific use for which the impeller is intended.

The diameter of the impeller body 2 illustrated in figures 1 and 2 increases gradually from its front end 4 to its rear end 5; on the front side, it is bounded by a concave surface 6 facing forwards and radially outwards and comprises in this example six radial blades 7 of which the outer edge 8 is adapted to be inscribed in a cylinder concentric to the impeller axis; furthermore, on its rear side the impeller body 2 has fitted therein a sealing ring 9 with the interposition of a flanged rubber ring 10.

In the forms of embodiment illustrated in figures 3 and 4 of the drawings the blades are not radial and therefore their upper and lower section 11, 12 taken through a same diametral plane differ in shape; the sealing ring 13 of figure 3 is fitted to the tubular rear extension 14 of the impeller body 2 with the interposition of a flanged rubber ring 15 formed with an integral annular bead 16 providing a static seal between the shaft 17 to which the impeller is fitted and the impeller body; alternatively, in the form of embodiment illustrated in figure 4 the sealing ring is replaced by a deposit 18 of a suitable material of refractory or other nature, formed by using a plasma gun.

The pressed metal hub 22 illustrated in Figure 7 and force fitted to the shaft 20 is so shaped that its outer peripheral portion 26 remains static while the hub-forming portion 25 and the curved intermediate portion 24 expand slightly during the press-fitting operation. The plastics impeller 21 is driven and retained positively in the metal hub by means of the peripheral outer portion 26, a hollow space 23 being easily obtained on either side of the intermediate portion 24 during the molding operation. It is clear that the axial off-set between the portions 24 and 26 of this hub is characterised by an indirect relationship between the distortions of portion 24 and those of portion 26, thus reducing their magnitude.

Other forms of embodiment of hubs suitable for different impeller configurations as well as other positions for centrally anchoring the impeller to the hub are illustrated in figures 8 to 12 inclusive of the drawings, which are self-explanatory.

In the forms of embodiment illustrated in

figures 13 and 14 the hub is machined from bar stock metal on a lathe, so that substantial differences in thickness between the various cross-sectional portions can be obtained.

It was also found that in order to further widen the field of the present invention it was advantageous to incorporate an elastomer or other flexible material in the thermosetting resin and filler mentioned hereinabove, in order to improve the flexibility of the molded impeller; however, this addition should be kept within reasonably low limits, for example less than 30% by weight, in order to avoid any detrimental influence on the characteristics of the basic mixture.

Of course, it will readily occur to those conversant with the art that the specific forms of embodiment shown, described and suggested herein should not be construed as limiting the scope of the invention, since various modifications and changes may be brought thereto without departing from the basic principle of the invention as set forth in the appended claims. Thus, the shape of the impeller body the number, arrangement and profile of the blades may vary considerably as a function of the specific function devolved to the impeller.

WHAT WE CLAIM IS:—

1. Impeller for pumps of the type incorporated in the cooling system of internal combustion engines, said impeller comprising a metal hub adapted to be force fitted on the pump shaft, and an impeller proper having one portion of said hub embedded therein, said impeller consisting of a mixture of thermosetting resin having a low coefficient of water absorption when heated, and a filler which is both water repellent and not liable to change its dimensions in the presence of water.

2. Impeller according to claim 1, wherein said thermosetting resin in a phenol-formaldehyde resin.

3. Impeller according to claim 2, wherein said thermosetting resin consists of moulding powder known under the Trademark "ALBERIT 1349" manufactured by the Hoechst Company.

4. Impeller according to any of the preceding claims, wherein said filler consists of short asbestos fibres.

5. Impeller according to any of the preceding claims, wherein said metal hub comprises a sleeve constituting the hub proper, which is connected through a curved and somewhat elastic intermediate portion to an outer portion, and that only this outer portion is embedded in the impeller proper.

6. Impeller according to any of the preceding claims, wherein said thermosetting resin is filled with an elastomer or other flexible material.

7. Impeller according to claim 6, wherein the proportion of elastomer or other flexible material is less than 30% by weight.

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Sheet 1

Fig.1.

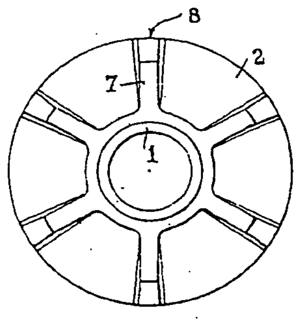


Fig.2.

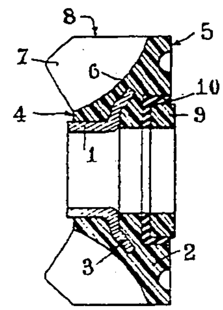


Fig.3.

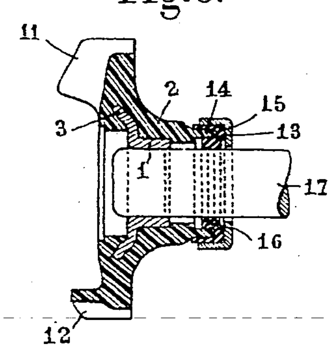
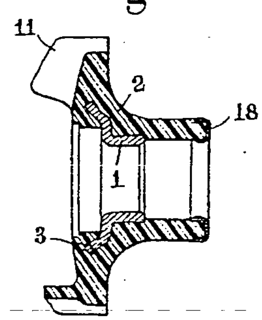


Fig.4.



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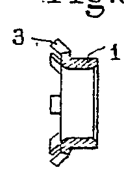

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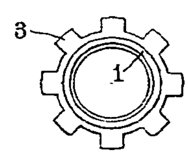

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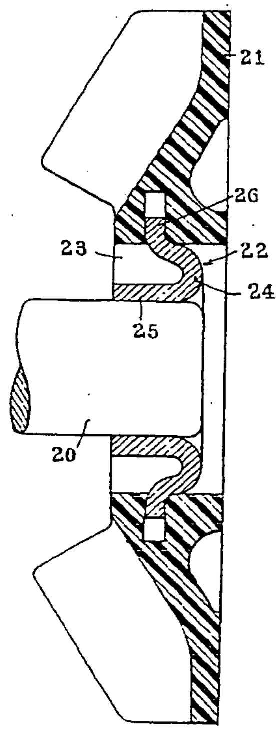

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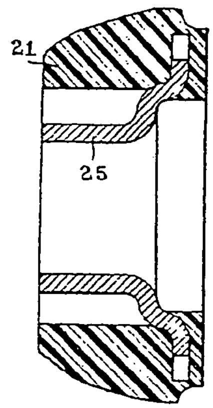

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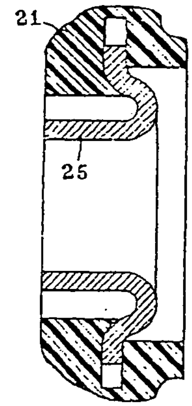

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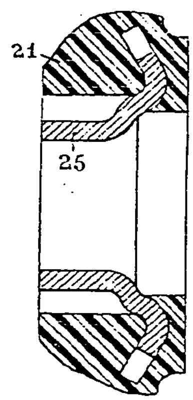
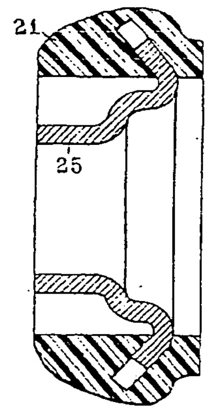


Fig. 11.



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Sheet 3

Fig:12.

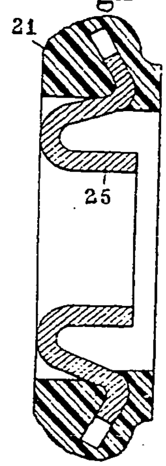

Fig:13.

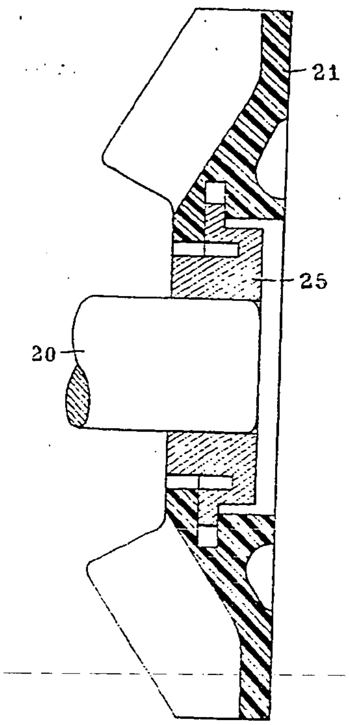

Fig:14.